On-the-fly and Grid Analysis of Astronomical Images

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http://www.xassist.org

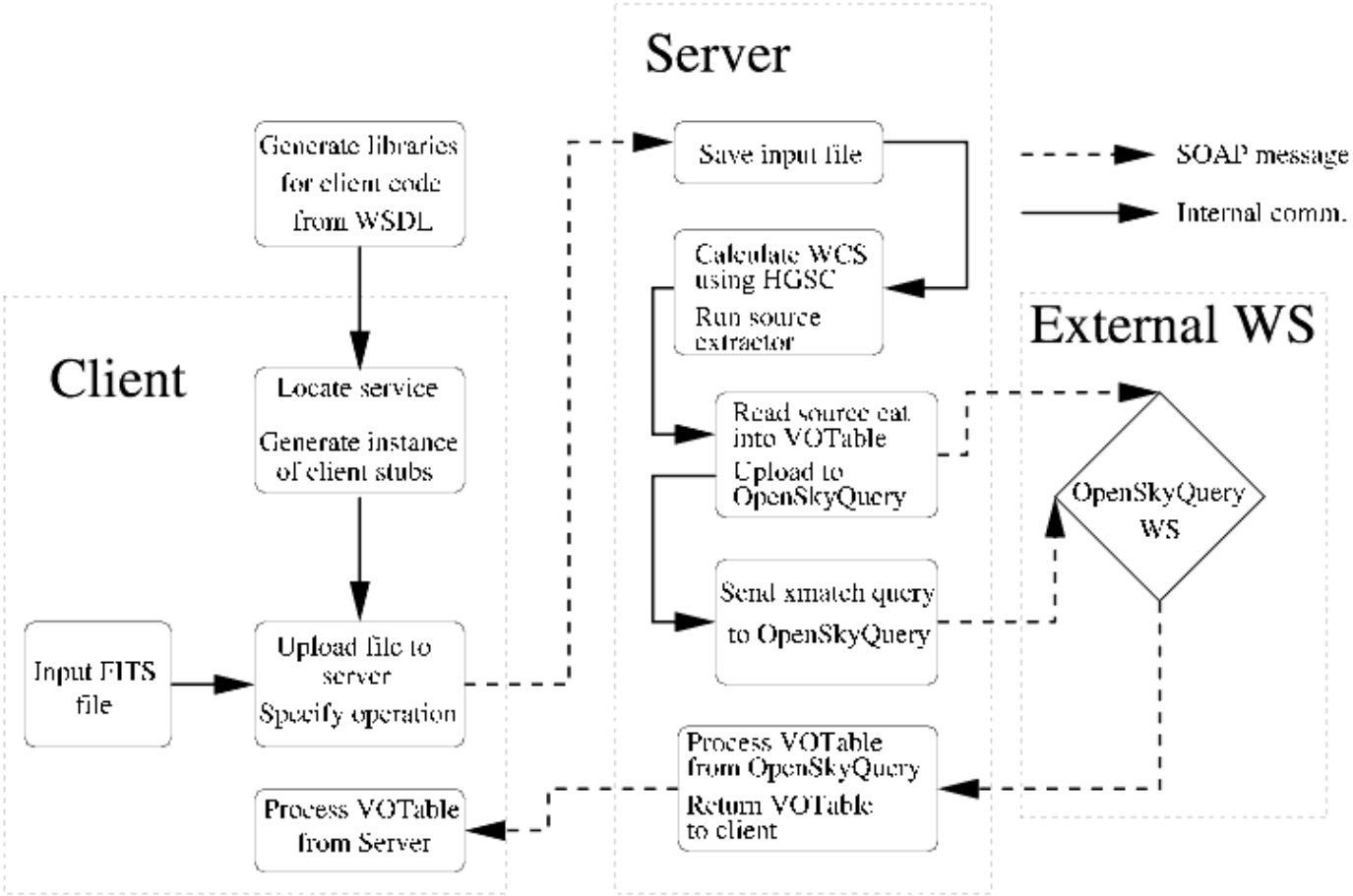
Thanks to Joe and the AISR program for support!

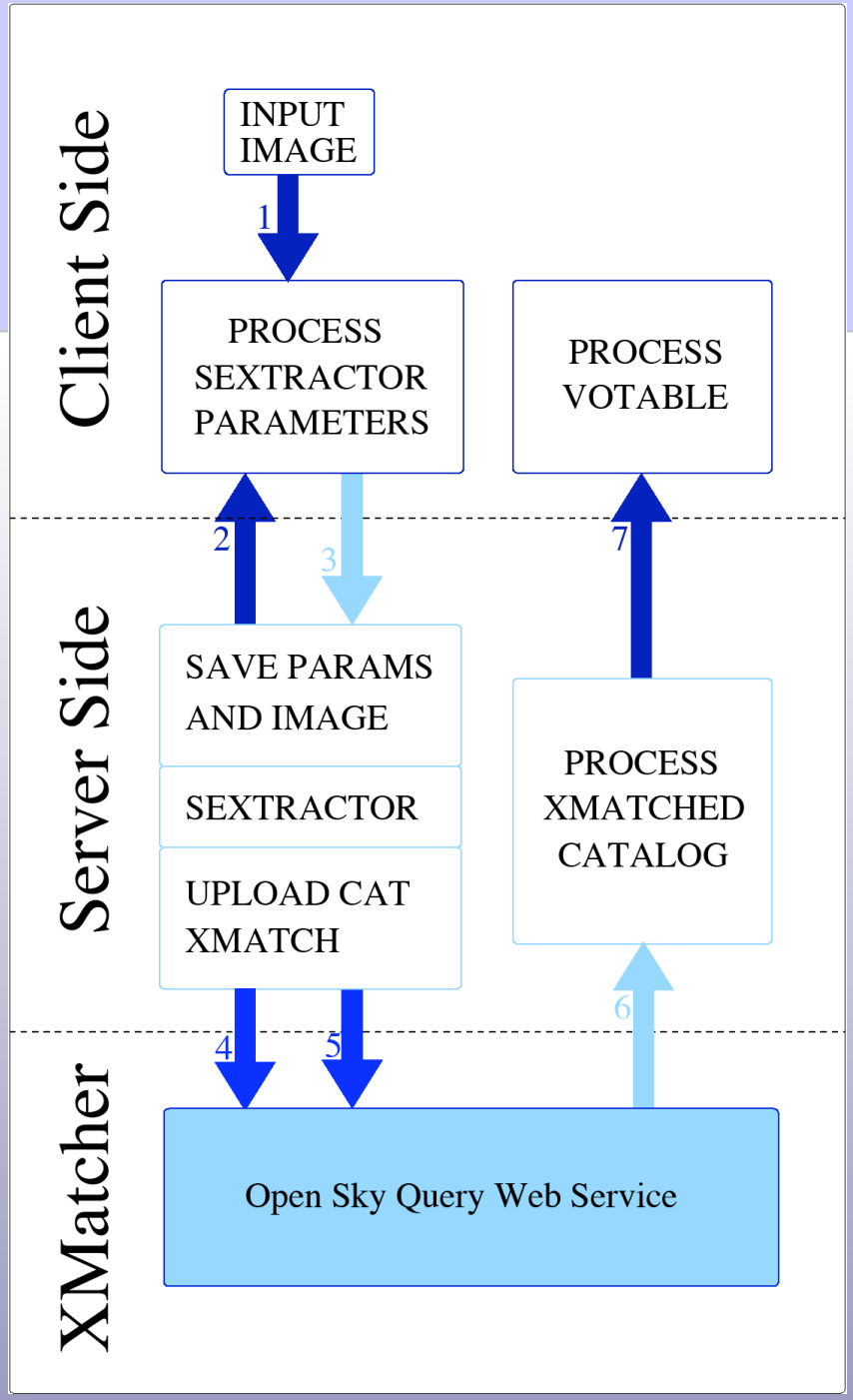
Overview

- WESIX is a web service for running the source detection and photometry program SExtractor on (optical) images
- XAssist is a package for automatically analyzing X-ray data
- AISR project goals:
  - Add web services to XAssist
  - Combine XAssist and WESIX into similar web services
  - Create a common framework for web service analysis of multi-wavelength data
- At start of 3rd year

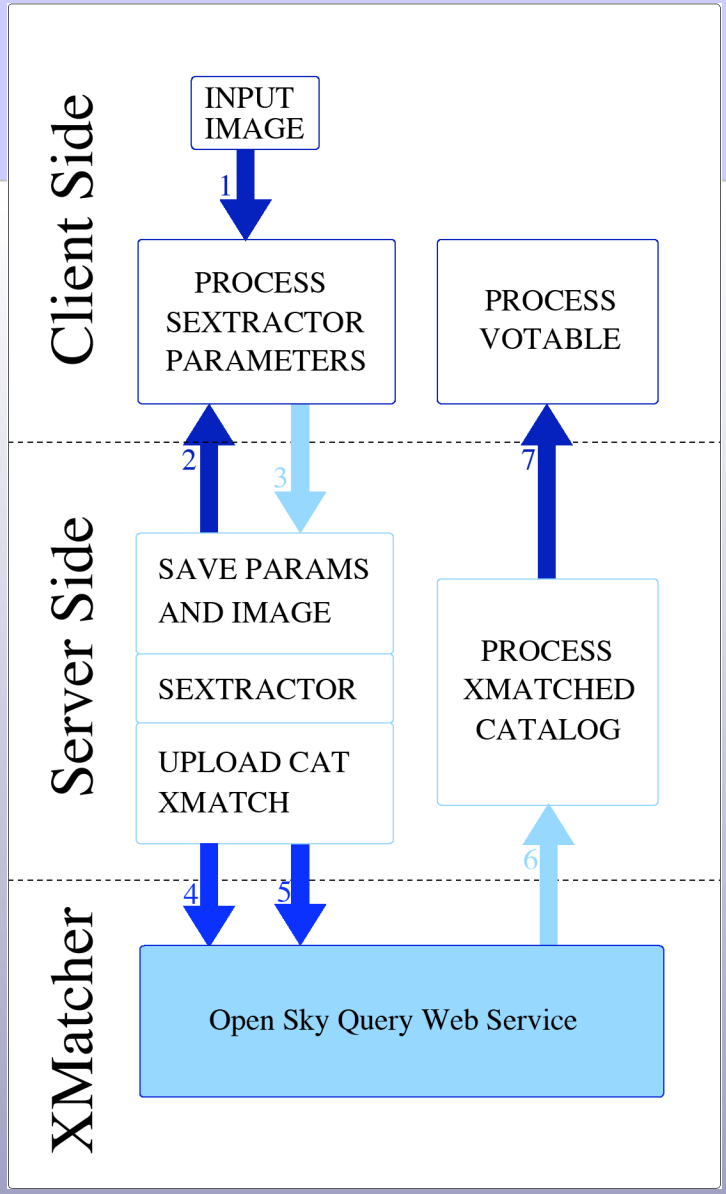
Introduction to WESIX

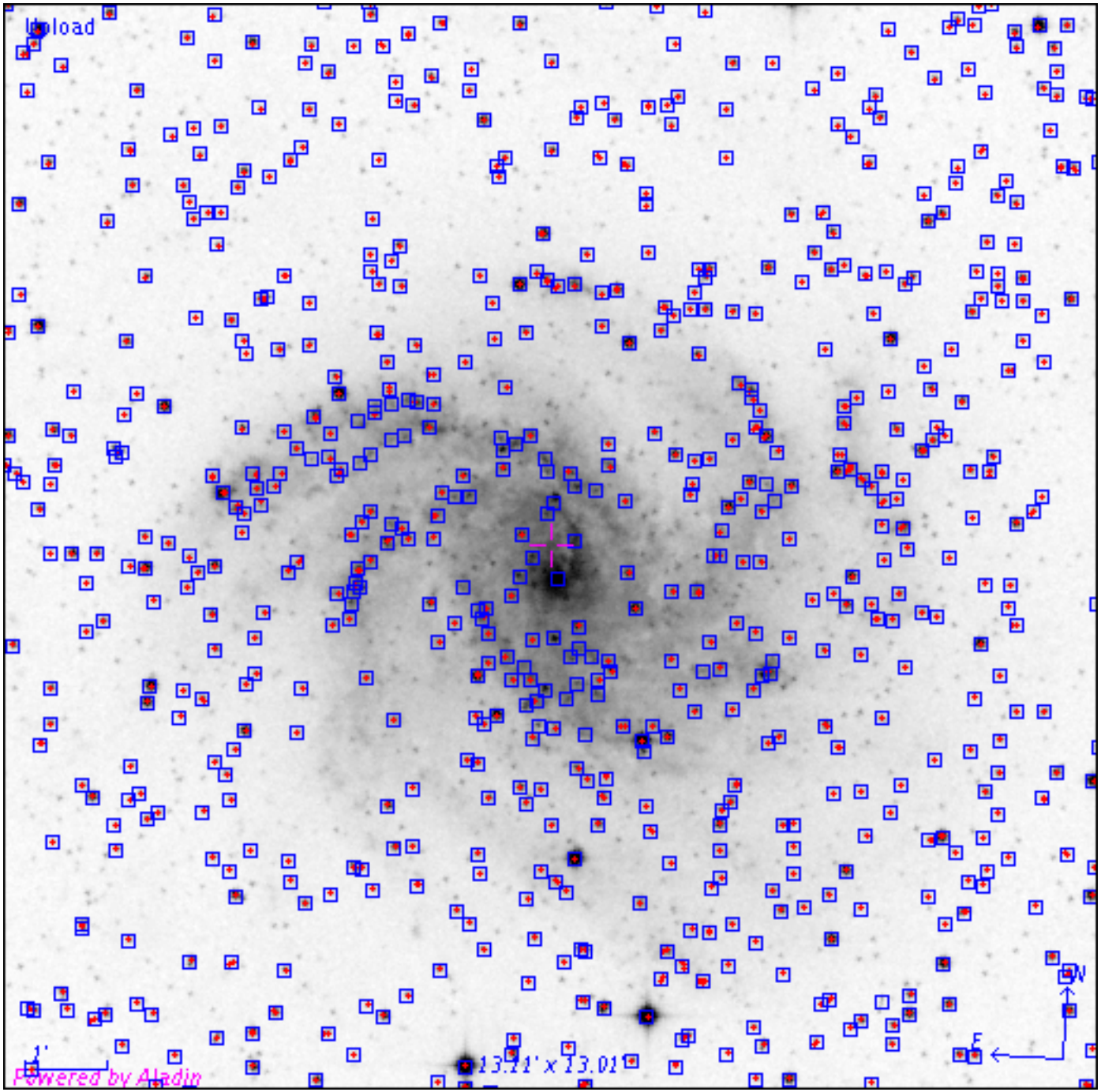
- WESIX is:
  - Web-Enabled Source Identification with X-matching
  - A web service with web page front end for extracting and cross matching sources in an astronomical image
  - Inputs are a FITS file with extraction parameters and catalog fields for output
  - Uses the SkyNode protocol from IVOA for cross matching with published catalogs.


Server
Generate libraries for client code from WSDL
Save input file
SOAP message
Internal comm.
Calculate WCS using HGSC
Run source extractor
External WS
Client
Locate service
Generate instance of client stubs
Read source cat. into VOTable
Upload to OpenSkyQuery
OpenSkyQuery WS
Send xmatch query to OpenSkyQuery
Input FITS file
Upload file to server
Specify operation
Process VOTable from OpenSkyQuery
Return VOTable to client
Process VOTable from Server


Client Side
Server Side
XMatcher
INPUT IMAGE
1
PROCESS SEXTRACTOR PARAMETERS
PROCESS VOTABLE
2
3
7
SAVE PARAMS AND IMAGE
SEXTRACTOR
UPLOAD CAT XMATCH
PROCESS XMATCHED CATALOG
4
5
6
Open Sky Query Web Service

1. Read FITS image with WCS
2. Request default parameters
3. Send image and parameters
4. Upload source list
5. Send ADQL query
6. Receive XMatched catalog
7. Return catalog to client.




Upload
1'
13.11' x 13.01'
N
E
Powered by Aladin

Current Development

- SOAP, Java, Axis → Python, XML-RPC
- Improvements:
  - No SOAP implementation issues
  - Multiple input images for weighted source identification and detect+measure images
  - Vector quantities for measurement of multiple apertures
  - Generalized framework for interaction with other source identification applications (XAssist)

WESIX Exposure

- Inclusion in the NVO Summer School 2005 and 2006
- Inclusion in the NVO book: *The National Virtual Observatory: Tools and Techniques for Astronomical Research*
- Integrated with the NOAO-NVO Portal (http://portal-nvo.noao.edu)
- Inclusion in the ESO Reflex (ESO Recipe Flexible Execution Workbench) presented ADASS 2007

XAssist

- Started as a previous AISR project (1998-2001)
- Written mostly in Python and scripts existing mission-specific software as much as possible (CIAO for *Chandra*, XMM-SAS for *XMM-Newton*, HEADAS for *Suzaku*)
- XAssist running pipelines to process *Chandra* and *XMM-Newton* data
  - Pipeline source lists searchable via HEASARC, which links search results to field reports at XAssist web site
- Japanese/US mission *Suzaku* pipeline recently started

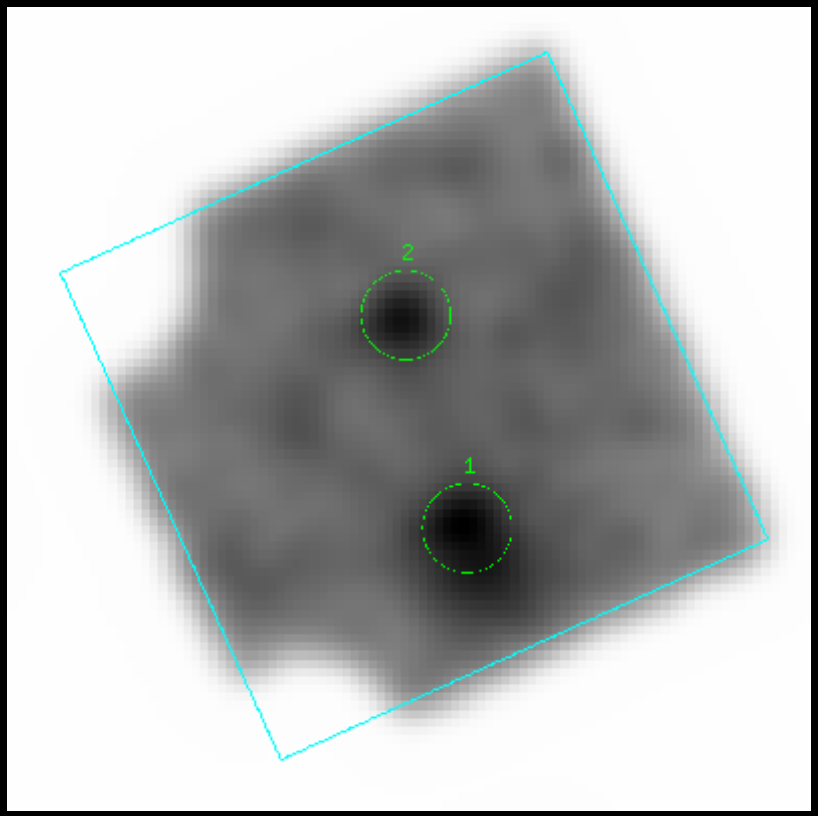
XAssist Features

- Downloads data
- Reprocesses data
- Creates detector mask
- Detects sources
- Excludes times of high background
- Fits each source with “simple” (i.e., not including PSF) model to establish source extent and (Poisson-correct) significance

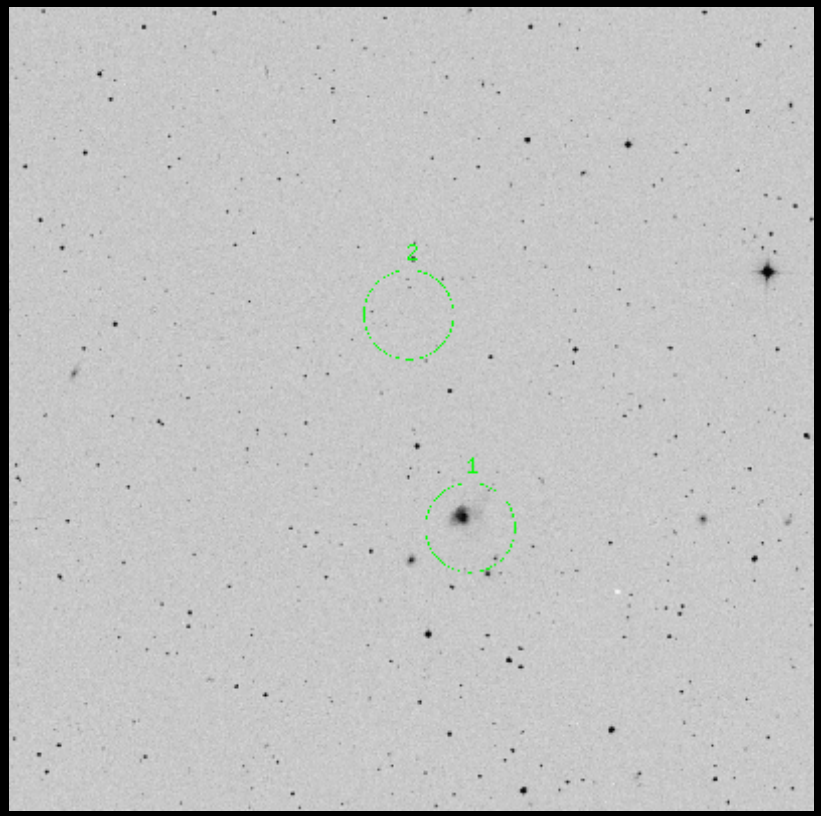
XAssist Features

- Flags extended, confused and problematic sources
- Median (or mean) background level is determined
- Extracts spectra, “postage stamp” images, and light curves of each source for more detailed analysis
  - Computes hardness ratios
  - Fits spectra with enough counts with simple power-law spectral model
- Analysis can be restricted to an energy band
- Optionally correlate source list with several HEASARC tables (USNO-B, Veron QSOs)
- Large emphasis on detailed reporting

Suzaku Observation of Arp 220

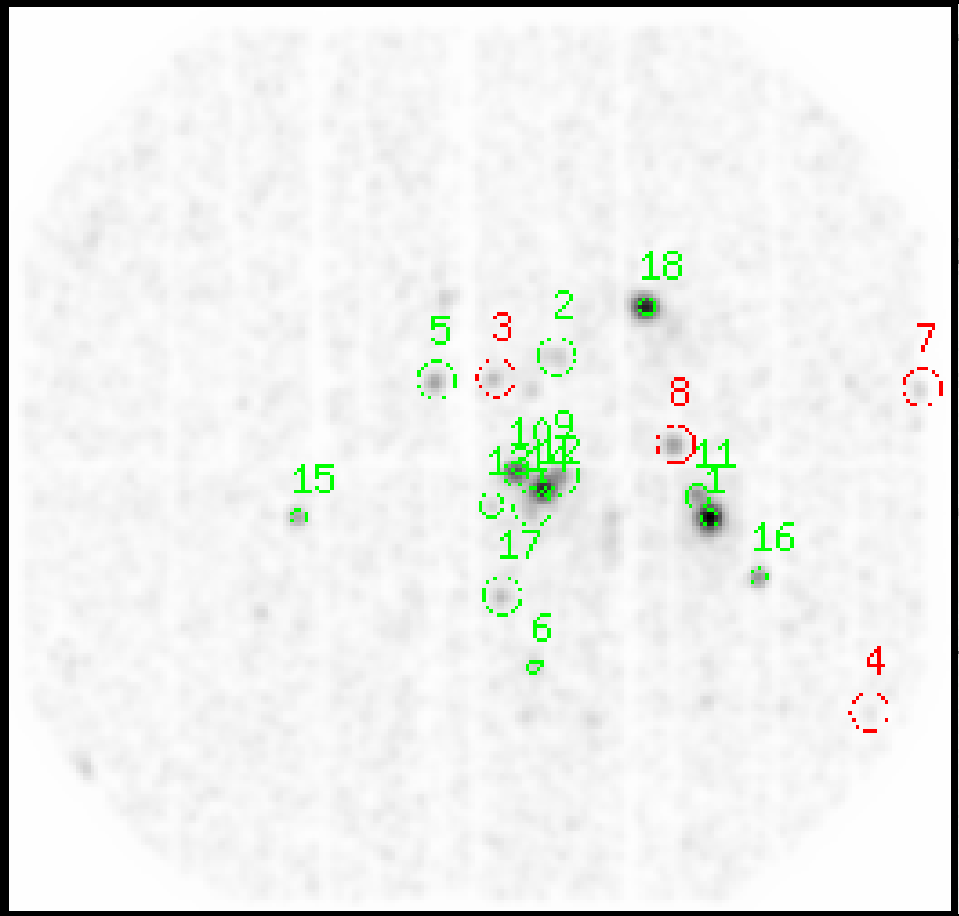


X-ray

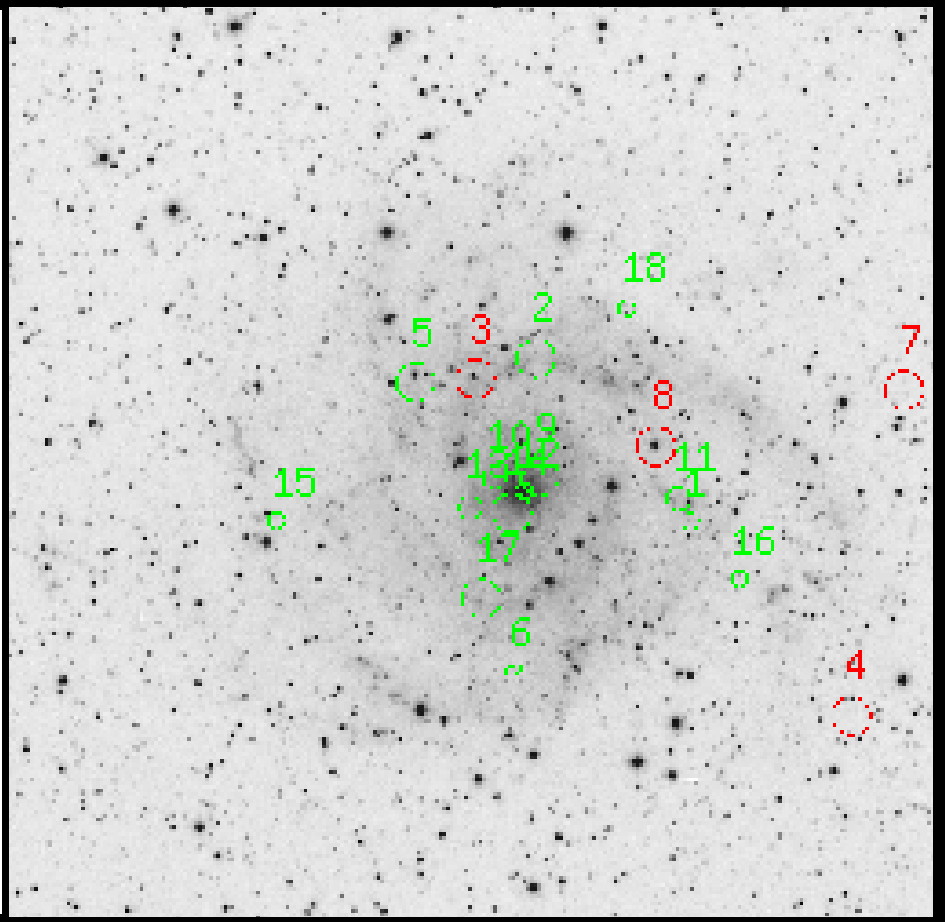


Digital Sky Survey

XMM-Newton Observation of IC 342

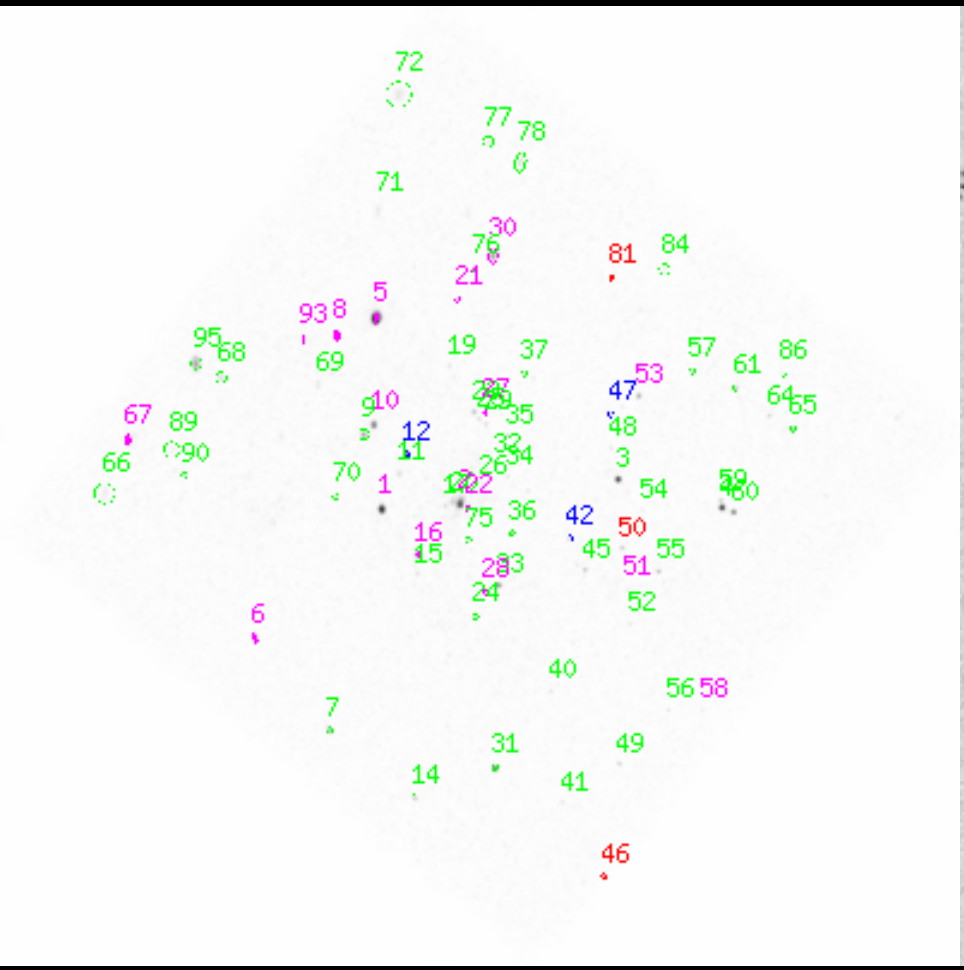


X-ray

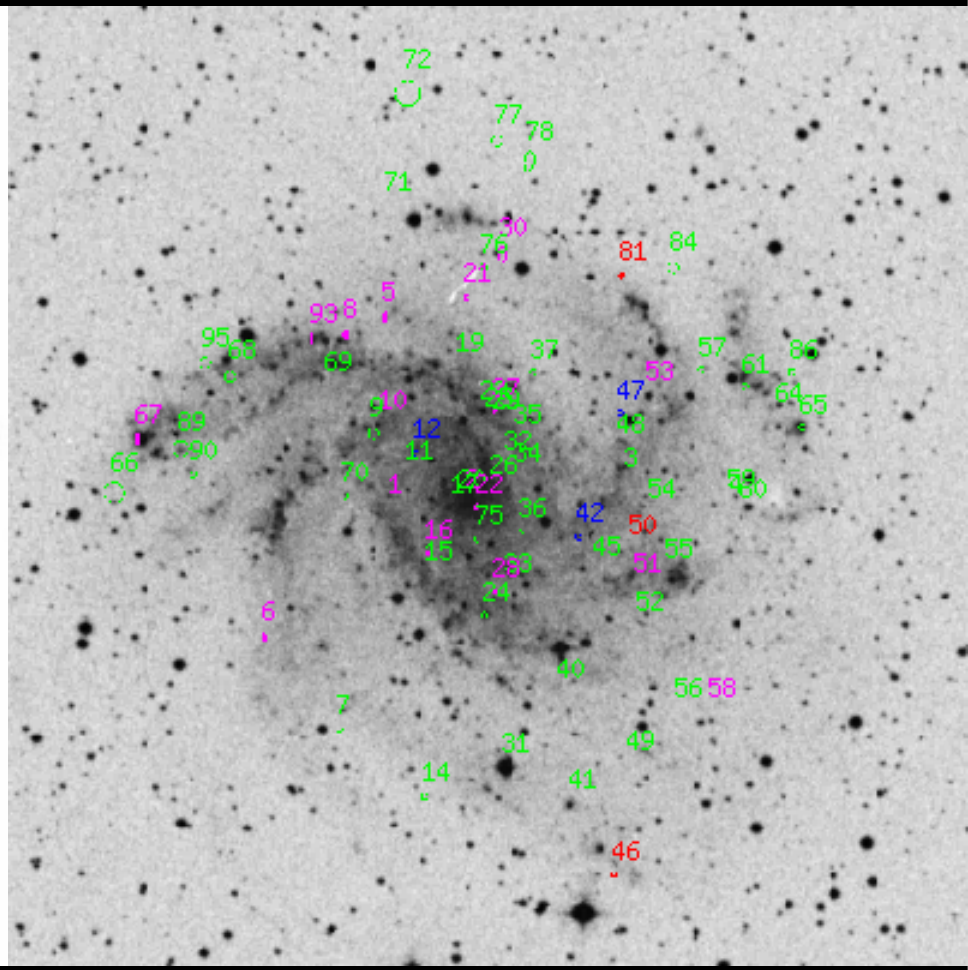


Digital Sky Survey

Chandra ACIS Observation of NGC 6946

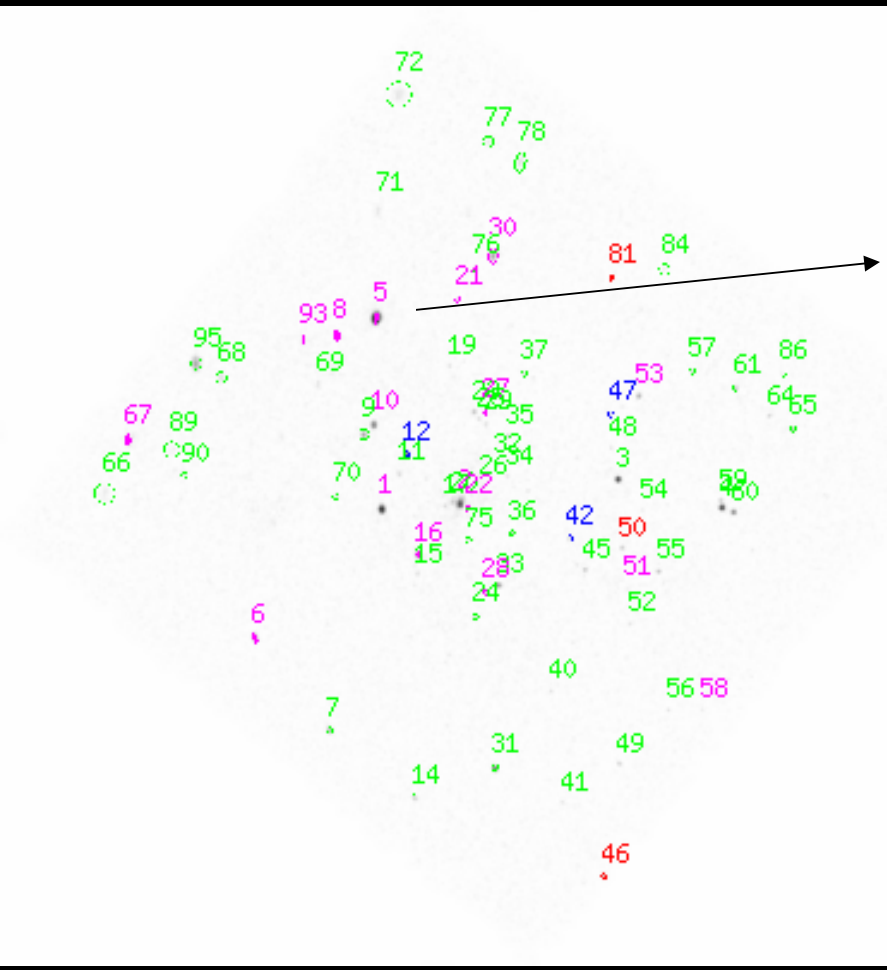


X-ray



Digital Sky Survey

Chandra ACIS Observation of NGC 6946

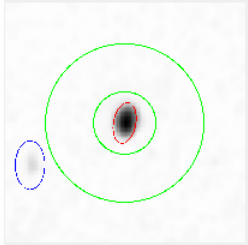


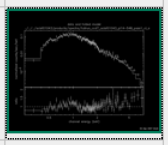
Source 5

http://xassist.pha.jhu.edu/pipeline3/chandra/1043

Latest Headlines | Yahoo! | News | Scientific Linux | Distros | macosxhints.com – ... | Getting Started | Latest Headlines

Source 5



Analysis Type	Results	Plot
Spatial	Source position = 20 35 0.80 60 11 30.4 Source region radii = 6.5", 3.7" Background annulus = 9.8" - 24.5"	N/A
Spectral	Nh = 0.235 (0.217 - 0.255) Gamma = 2.59 (2.5 - 2.7) Final chisq(dof) = 350.474(217) F(0.5-2.0 keV) = 3.785e-13 F(2.0-10.0 keV) = 3.647e-13 F(0.3-8.0) = 7.323e-13	
Temporal	K-S test against local background: d = 0.0486202, prob = 0.418468 K-S test against global background: d = 0.0133424, prob = 0.161803	N/A
Counterparts	Check SIMBAD	

Return to source list

Notes:

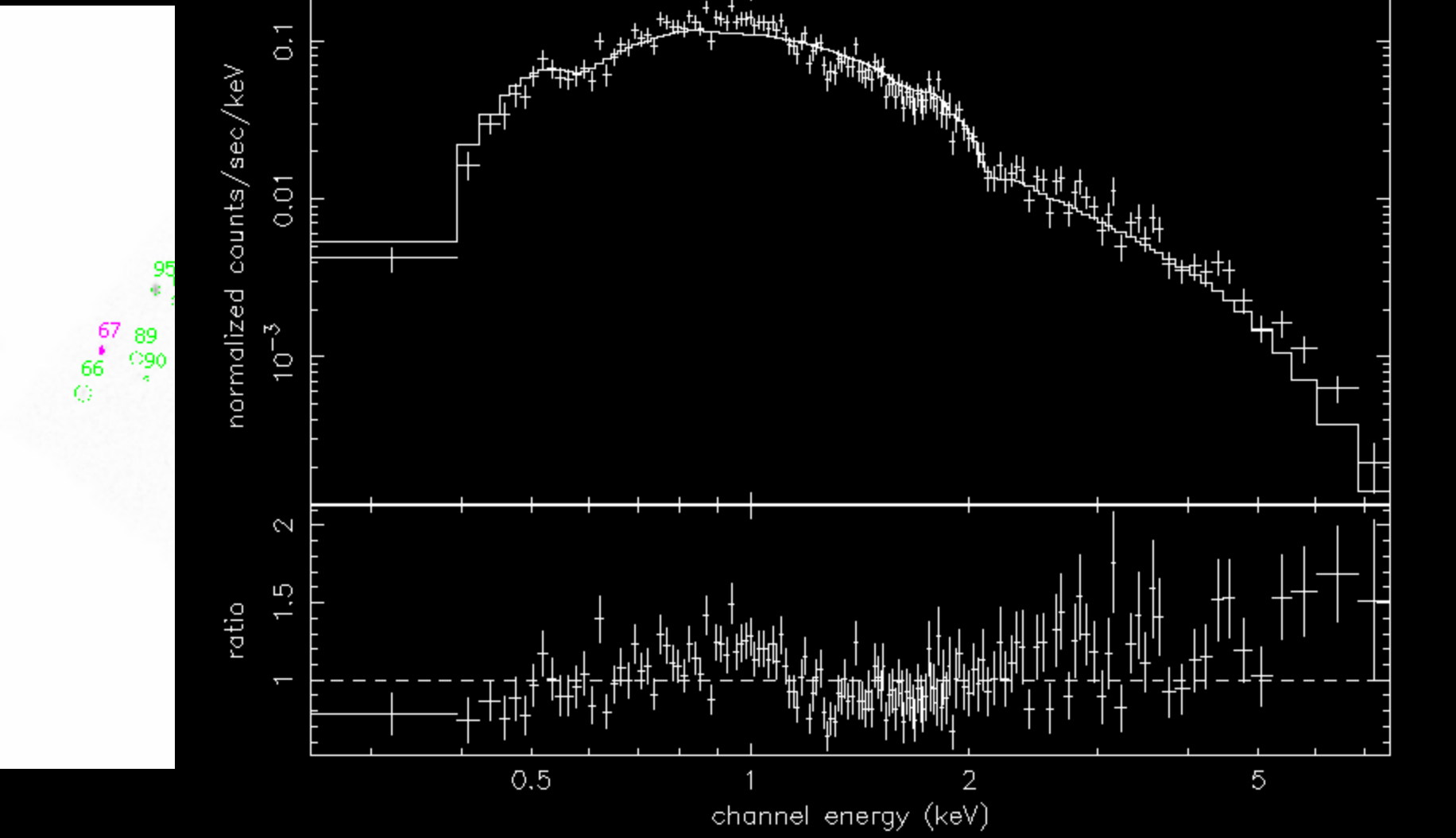
Regions give source ellipse (red) and bgd. annulus used in product extraction (green), other ellipse show nearby sources that have been excluded (blue, if any).N.B., nearby sources are NOT excluded from the source regions since in many cases that would also remove many source photons for the source of interest, and this case is more properly handled manually

Source variability probability gives the probability that the source light curve is consistent with the background light curve. "Local" background is taken from the annulus shown. "Global" background is the background light curve shown on the main report page.

Find: 342 | Next | Previous | Highlight all | Match case

Baltimore, MD: Tue 10:20 | Japan: Tue 23:20 | Spain: Tue 16:20 | Los Angeles: Tue 07:20 | Done

X-ray



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Current Development

- Adding web service for querying pipeline status, searching pipeline database and requesting processing (initial versions done and undergoing testing)
- Exposing individual XAssist processing steps as web services
  - Exposure at a given position (“footprint”)
  - Extracting spectra and image for a given source or position
    - Computing Bayesian confidence intervals for source significance
- Adding “quick-look” processing option
  - SExtractor for source detection
  - Streamlined (and often approximate) versions of other processing steps
- Simulation for completeness and Eddington bias correction

Joint WESIX/XAssist Development

- Testing/calibration of SExtractor on X-ray images
  - If X-ray image supplied to WESIX, run WESIX with X-ray specific defaults
- Add options to WESIX parameter input to allow X-ray dataset to be supplied
  - Spawn request to XAssist web service to check for existing processing of field
    - Yes: return data
    - No: start quick-look processing

Future Plans

- Web service access to XAssist and WESIX lends itself to distributed processing of X-ray and optical data
  - Will start joint analysis of Chandra, XMM and optical data
    - Optical images archived at major observatories
    - HST overlap with Chandra and XMM
- AJAX GUI for XAssist and WESIX
- Creating portal to allow users to specify source lists and/or regions to monitor for available data
  - Considering Plone, Trac, Django, Turbogears

Summary

- WESIX and XAssist are separately being developed to be more flexible and capable
- Joint web service access to both will open up multi-wavelength virtual observatory analysis capability using “intelligent” systems
  - Distributed analysis of large datasets that are public
  - Correlations even when there are “upper-limits” (often precludes simply using catalogs)
- Initial version will be running in time for ADASS 2008 meeting in November